Technical Report 1164

The Influence of Trainee Gaming Experience and Computer Self-Efficacy on Learner Outcomes of Videogame-Based Learning Environments

Karin A. Orvis
George Mason University
Consortium Research Fellows Program

Kara L. Orvis
Consortium Post-Doctoral Fellows

James Belanich
U.S. Army Research Institute

Laura N. Mullin
The Catholic University of America
Consortium Research Fellows Program

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A Directorate of the Department of the Army Deputy Chief of Staff, G1

ZITA M. SIMUTIS
Director

Technical Review by

Andrea Rittman Lassiter, Minnesota State University - Mankato
Jennifer Solberg, U.S. Army Research Institute

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Videogame-based environments are an increasingly popular choice to facilitate training. The purpose of the current research was to investigate the influence of two trainee characteristics, prior videogame experience and computer self-efficacy, on learner outcomes of a videogame-based training environment. In this research, 413 participants played a first-person-perspective videogame that began with a single-player section to introduce game-specific tasks, followed by a multi-player section where participants formed small teams to conduct several collaborative missions. Results indicated that computer self-efficacy and prior videogame experience were predictive of several learner outcomes such that trainees with greater computer self-efficacy and prior videogame experience reported less difficulty using the game interface and greater team cohesion, training satisfaction, and training motivation. Further, a videogame genre-specific effect was demonstrated in that only specific prior game experiences that share similar characteristics with the current training game were significantly predictive of the learner outcomes. These findings have implications for training game developers and instructors utilizing such games.

15. SUBJECT TERMS
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Karin A. Orvis
George Mason University
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James Belanich
U.S. Army Research Institute

Laura N. Mullin
The Catholic University of America
Consortium Research Fellows Program

Research and Advanced Concepts Unit
Paul A. Gade, Chief

U. S. Army Research Institute for the Behavioral And Social Sciences
2511 Jefferson Davis Highway, Arlington, Virginia 22202-3926

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FOREWORD

The U.S. Army Research Institute for the Behavioral and Social Sciences (ARI), as part of its Training for Interactive Distributed Environments work package, is investigating the use of training technology that is effective, affordable, and distributable. ARI seeks to provide the Army with guidance on how game-based training tools can be used for military training.

The focus of this research effort was to assess how trainee characteristics specific to previous computer and videogame experiences impact training outcomes of a game-based training environment. The game used for this research was the *America's Army* game. *America's Army* was developed by the Office of Economic and Manpower Analysis to serve as an interactive tool for providing potential recruits with information regarding U.S. Army opportunities. The game has been well received by the public with over four million registered players. In Janurary 2004, *America's Army* was used during a four-day inter-semester game-based training exercise at the U. S. Military Academy. This game was used to further develop cadet tactics skills and was chosen because of its ability to allow for the virtual simulation of small team maneuvers.

A summary of this research was briefed to representatives from the Research, Development, Experimentation Command/Simulation and Training Technology Center; the Training and Doctrine Command—Training Development and Analysis Directorate; the Army Research Lab – Human Research & Engineering Directorate; and the Institute for Creative Technologies on 28 September 2004. The findings of this research were also presented at the E-Learn World Conference on E-Learning in Corporate, Government, Healthcare, and Higher Education Conference in November 2004, where it received the Outstanding Paper Award, and at the American Psychological Association Division 19/21 Annual Symposium on Applied Experimental Research in March 2005, where it received the Dr. Jimmy Mitchell Award for Best Graduate Student Poster.

MICHELLE SAMS
Technical Director

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THE INFLUENCE OF TRAINEE GAMING EXPERIENCE AND COMPUTER SELF-EFFICACY ON LEARNER OUTCOMES OF VIDEOGAME-BASED LEARNING ENVIRONMENTS

EXECUTIVE SUMMARY

Research Requirement:

Videogame-based environments are an increasingly popular choice to facilitate training. The purpose of the current research was to investigate the influence of two trainee characteristics, prior videogame experience and computer self-efficacy, on learner outcomes of a videogame-based training environment (i.e., ease in using the game interface, team cohesion, training satisfaction, and training motivation). Additionally, this research sought to analyze the contribution of specific types of videogame experience versus general videogame experience in predicting learner outcomes.

Procedure:

In this research, 413 participants played a first-person-perspective videogame that began with a single-player section to introduce game-specific tasks, followed by a multi-player section where participants formed small teams to conduct several collaborative missions. Following the four-day training game exercise, participants completed an online questionnaire.

Findings:

Results indicated that computer self-efficacy and prior videogame experience were predictive of several learner outcomes such that trainees with greater computer self-efficacy and prior videogame experience reported less difficulty using the game interface and greater team cohesion, training satisfaction and training motivation. Further, a videogame genre-specific effect was demonstrated in that only specific prior game experiences that share similar characteristics with the current training game were significantly predictive of the learner outcomes. Additionally, results indicate that there is a wide range of prior videogame experience across the military participants in this sample, with 17% of cadets reporting they have no experience playing videogames and 44% reporting they have limited videogame experience.

Utilization of Findings:

The results of this research provide useful information to individuals developing or using game-based training environments. This research extends prior findings by demonstrating the importance of trainee characteristics such as prior videogame experience and computer self-efficacy for the prediction and explanation of learner outcomes in videogame-based training. It is suggested that modification of these trainee characteristics prior to training would help to enhance training outcomes.

THE INFLUENCE OF TRAINEE GAMING EXPERIENCE AND COMPUTER SELF-EFFICACY ON LEARNER OUTCOMES OF VIDEOGAME-BASED LEARNING ENVIRONMENTS

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Introduction

Videogames are emerging as an increasingly popular tool in helping to train and ensure the preparedness of U.S. Army Soldiers (Herz & Macedonia, 2002). As opposed to the more traditional lecture-based form of training, training games allow for greater interactivity as well as providing realistic feedback and multi-sensory stimulation (Garris, Ahlers, & Driskell, 2002; Tarr, Morris, & Singer, 2002). These games are found to be intrinsically motivating and can facilitate learning (Gee, 2003; Prensky, 2001). Research also indicates that skills learned in game-based training environments transfer to real-life situations (Gopher, Weil, & Bareket, 1994; Knerr, Simutis, & Johnson, 1979).

Given the increasing popularity of using videogames for training, it is important to investigate factors that maximize the effectiveness of this training medium. The training literature suggests that training effectiveness is influenced by three primary determinants: a) the training program itself (e.g., the actual videogame), b) the trainee (in terms of personal characteristics and attitudes), and c) the situational context in which the training takes place (Campbell & Kuncel, 2001; Colquitt, LePine, & Noe, 2000; Mathieu, Tannenbaum, & Salas, 1992; Salas & Cannon-Bowers, 2001). Available research on training games has primarily focused on the first determinant of training effectiveness: videogame features or characteristics. Game features such as challenge, realism, and interactivity have been found to influence trainee motivation and the length of time in which trainees are willing to invest in mastering the skills taught during game play (e.g., Belanich, Sibley, & Orvis, 2004; Corbeil, 1999; Garris et al., 2002). Such research has enhanced our understanding on how to design the actual training game to improve its effectiveness. Yet, to date, little emphasis has been paid to the second determinant of training effectiveness; namely, how trainee characteristics influence learner outcomes in videogame-based training environments.

There is reason to believe that individual characteristics of the trainee may play an important role in predicting learner outcomes. Limited research on e-learning environments has found that trainees' characteristics significantly influence learner outcomes such as learning and motivation to train. Both stable characteristics, such as personality traits, and more malleable characteristics, such as prior computer experience, have been found to predict e-learning outcomes (Brown, 2001; Orvis, Fisher, & Wasserman, 2003; Schmidt & Ford, 2003). The purpose of the current research is to investigate the influence of trainee characteristics on training motivation and other learner outcomes in videogame-based learning environments. Specifically, this research focuses on two malleable trainee characteristics that may be particularly relevant in a videogame-based training environment: trainee's prior videogame experience and computer self-efficacy. These characteristics were chosen because instructors have the ability to influence them prior to training implementation in an effort to ensure maximum training effectiveness. In contrast, stable characteristics, such as personality variables, are not easily altered. The ability to identify the individual attributes that lead to success in game-based training environments will help to better prepare Soldiers for training and will lead to increased operational capabilities.

Learner Outcomes of Game-Based Training Environments

The fundamental goal of training is to positively impact learners in terms of their knowledge, skills, and/or attitudes; therefore, identifying training variables that influence learner outcomes will lead to enhanced training effectiveness. The current research focuses on four learner outcomes that are significant in videogame-based training environments: training motivation, training satisfaction, ease in using the training game's user interface, and perceived cohesion with one's teammates while playing the game.

One of the principal perceived benefits of using videogames for training purposes is that they are motivating for individuals to play (Prensky, 2001). Therefore, motivation to train is of particular interest to the current research. Motivation can be defined as the direction, strength, and persistence of volitional behavior (Campbell & Kuncel, 2001); and in the context of instruction, the volitional behavior can be the purposeful engagement in or interaction with the instructional media. Motivation to learn in a training program has been found to predict subsequent training outcomes such as skill and knowledge acquisition and retention (Colquitt et al., 2000; Mathieu et al., 1992; Tannenbaum & Yukl, 1992). Unfortunately, literature on computer-based instruction has also found that trainees do not always make choices that increase learning. For example, trainees sometimes terminate training before learning the intended training objectives, in part, because of low training motivation levels (Steinberg, 1989). Thus, ways in which to maximize an individual's level of training motivation is of great concern to instructors and is an important outcome to investigate in videogame-based learning environments.

Another outcome of interest to the current research is the learner's satisfaction with the training game experience. Training satisfaction focuses on both emotionally-based opinions concerning the training (e.g., the trainee liking the training) and reactions regarding the utility of the training (e.g., the trainee believing the training enhanced his/her knowledge or skills). Trainees' level of satisfaction with the training has been found to influence learning in an e-learning environment (Wasserman, Orvis, Fisher, & Barry, 2002). This may be because when trainees are more satisfied with their training experiences, they are likely to stay engaged for longer periods of time or put forth greater mental effort in trying to learn the training content, thus resulting in greater levels of learning.

The perception of ease in using the training game interface is another criterion that should influence the level of engagement in a videogame-based training environment. If e-learning environments are frustrating and difficult to use, trainees may experience decreased motivation and not fully engage in the program (Park & Tennyson, 1980; Tennyson, 1980). Difficulties with the technology or interface in which the training content is delivered has been cited as a key frustration source and a reason for low completion rates in e-learning programs (Frankola, 2001). Moreover, prior research has found that trainees' perceptions regarding the user interface of an e-learning training program were positively related to their satisfaction with the overall training; which, in turn, positively influenced learning (Wasserman et al., 2002). This suggests that the ease in using a game's user interface is a valuable learner outcome in game-based learning environments.

Finally, many training videogames are collaborative in nature, requiring the interaction and cooperation among trainee team members in order to be successful in the game and to learn the training content. Previous collaborative learning research has found that the quality of intra-team interactions is a key element in determining the extent and depth of learning in such environments (Gilbert & Moore, 1998; Northrup, 2001; Shute, Lajoie, & Gluck, 2000; Wagner, 1997). Quality team interactions originate, in part, from collaborative team states such as team cohesion. Indeed, team cohesion, most commonly defined as members liking for one another (Evans & Jarvis, 1980) and the extent to which team members are attracted to the idea of the group (Hogg, 1992), has been found to be directly related to group effectiveness (Evans & Dion, 1991; Mullen, Anthony, Salas, & Driskell, 1993; Mullen & Copper, 1994). Effective collaboration is also critical to the unit combat performance of Soldiers. Accordingly, this suggests that the level of cohesion trainees perceive with their teammates is an important learner outcome to investigate in collaborative game-based learning environments.

Prior Computer Experience

In general, research on the relationship between experience and various computer-based attitudinal and learning outcomes is equivocal. Some research found that previous experience is positively related to computer-related attitudes, such as interest and comfort with electronic learning (Dias, 2000; Dyck & Smither, 1994; Houle, 1996; Rozell & Gardner, 1999; Shashaani, 1994); and negatively related to anxiety in using computers (Dyck & Smither, 1994; Keeler & Anson, 1995). Additional research has found previous experience to have a positive influence on computer-based learning, such that computer experience positively predicts time spent in a distributed learning class (Patterson, 1999), motivation to learn, and actual learning in a computer-based training course (Dyck & Smither, 1996; Martocchio & Webster, 1992). In contrast, other research has found no clear relationship between previous experience and computer-based outcomes (Kay, 1992). For instance, some research either failed to find or found mixed results regarding the relationships between computer experience and anxiety in using computers (Henderson, Deane, Barrelle, & Mahar, 1995; Houle, 1996; Rozell & Gardner, 2000) and computer-related attitudes (Henderson et al., 1995; Woodrow, 1991). Moreover, other research failed to find a relationship between experience and time spent in a distributed learning course (Brown, 2001).

Several researchers have suggested that these mixed findings may be due, in part, to the different approaches taken to operationalize prior computer experience (Hasan, 2003; Smith, Caputi, Crittenden, Jayasuriya, & Rawstone, 1999). The majority of studies examine experience with computers globally as a unidimensional construct, and address level of computer experience as the frequency or length of time of general computer use (e.g., Al-Khaldi & Al-Jabri, 1998; Loyd & Loyd, 1985; McInerney, McInerney, & Sinclair, 1994; Salzer & Burks, 2003). Operationalizing experience as a global measure does not account for experiences with specific types of computer applications, such as word processing, spreadsheets, data analysis, computer games, e-mail, or programming. As such, the implicit assumption is that one type of computer experience is equivalent to all others, and any computer experience should positively influence subsequent training in a completely different type of computer task.

Such an assumption may not be appropriate. Some research demonstrates that specific computer experiences are differentially related to learning outcomes in computer-based learning environments (Polman & Fishman, 1995; Salanova, Grau, Cifre, & Llorens, 2000; Woodrow, 1991). For example, Woodrow (1991) found that prior programming experience significantly predicted learning (measured as final course grade) in a computer training course, while prior word processing experience was not predictive of learning. Woodrow explained that the final course grade was heavily skewed toward programming ability rather than other applications such as word processing. Such findings indicate that previous experiences with tasks and technology similar to the given computer-based training environment are most predictive of attitudes and performance in such learning environments. As such, a growing number of researchers have begun to adopt a multidimensional view of computer-related experience, arguing that reducing experience to a unidimensional construct has resulted in an oversimplication of the construct (Smith et al., 1999; Szajna & MacKay, 1995). This line of research advocates that measurements of computer experience assess diversity of computer experience, in terms of familiarity or frequency of use of various computer technology applications (e.g., Anderson & Reed, 1998; Busch, 1995; Chu, 2003; Chua, Chen, & Wong, 1999; Hasan, 2003; Polman & Fishman, 1995). It also suggests that the validity of computer experience as a predictor of training outcomes depends upon the relatedness of the particular training criterion of interest (e.g., particular learner outcomes) and type of computer experience examined.

Although it seems that the relevance of computer experience (i.e., the degree of similarity between the prior experience and current training environment) rather than the quantity, may be the most predictive of training criteria, much of the research subscribing to a multidimensional view of experience continues to analyze the relationships between computer experience and learning criteria using a summative composite measure of various experience types (e.g., Bozionelos, 2001; Gardner, Discenza, & Dukes, 1993). As a result, while prior research does demonstrate that previous experience with computer applications is predictive of success, less is known about the particular types of experience that are most relevant to a given learning context. More research is needed to better understand what types of experiences contribute most to success in a given technology environment. It is useful to understand whether one type of previous technology experience significantly contributes to the prediction of learner outcomes, such as training motivation, satisfaction and learning, in a different type of environment.

Videogame experience. There is a paucity of research on the influence of prior experience on learner outcomes of *videogame-based* training environments. The prior training game research has primarily focused on enhancing our understanding of the features or characteristics of the videogame that impact training effectiveness (e.g., Belanich et al., 2004; Corbeil, 1999; Garris et al., 2002). Research that has investigated prior experience in gaming environments tends to mirror the majority of work on previous computer experience, operationalizing the experience construct as general experience in using computers, regardless of the particular types of computer experiences one has acquired. Some subsequent gaming research has examined prior experience with videogames in particular and found that prior overall or *general* videogame experience (regardless of the type of videogame previously played) was related to future game performance in videogame-based environments (Gagnon, 1985; Young, Broach, & Farmer, 1997).

We propose that trainees' previous videogame experience will predict the four learner outcomes of interest: training motivation, training satisfaction, ease in using the game interface, and perceived team cohesion (*Hypothesis 1*). For the purpose of this research, previous videogame experience is operationalized as any game experience with computer-based videogames or console-based videogames (e.g., Playstation, Xbox). Specifically, we suggest that trainees with greater levels of experience (e.g., those who play videogames on a more frequent basis for personal enjoyment purposes) should be more motivated to engage in such environments for training purposes as well. Baldwin & Magjuka (1997) suggest that the motivating influence of any training design element is partially contingent on the trainees' accumulated experience with that design element in other settings. Thus if trainees have had frequent, positive experiences with videogames in the past, they should be more likely to find such environments motivating in the future. Further, because trainees with greater levels of videogame experience enjoy this type of environment, they should be more satisfied with gaining new knowledge or skills from a training environment with similar characteristics, as compared to trainees who have not had much exposure to this type of environment in the past. In support of this proposition, previous research on computer-based training contexts has found that frequency of computer use (i.e., prior computer experience) is positively related to favorable attitudes towards computers (Mitra, 1998).

Previous experience with a game interface should also lead to the development of strategies and heuristics that smooth a trainee's navigation in a similar environment. Prior research has found that training programs in which the learner is primarily responsible for his/her own learning, as is often the case in e-learning and game-based learning environments, are more successful for trainees who have greater levels of prior knowledge on the relevant topics (Lee & Lee, 1991; Gay, 1986). We suggest that a trainee's prior knowledge of videogames (e.g., knowledge of videogame interfaces obtained from prior experiences playing videogames) will enable the trainee to feel more at ease when presented with a similar training environment. Similarly, we suggest that trainees with little prior experience working with others and building positive relationships in collaborative virtual learning environments are likely less equipped with the knowledge of how to interact effectively in such environments. Thus, trainees with less prior collaborative videogame experience will have more difficulty forming cohesive relationships in future videogame-based training environments that require virtual collaboration.

In addition, we suggest that trainees' perceived cohesion with their team members, ease in using the game's interface, and training satisfaction will partially explain the relationship between prior general videogame experience and motivation to continue training with the videogame (*Hypothesis 2*). A conceptual model for these proposed mediated relationships is shown in Figure 1.

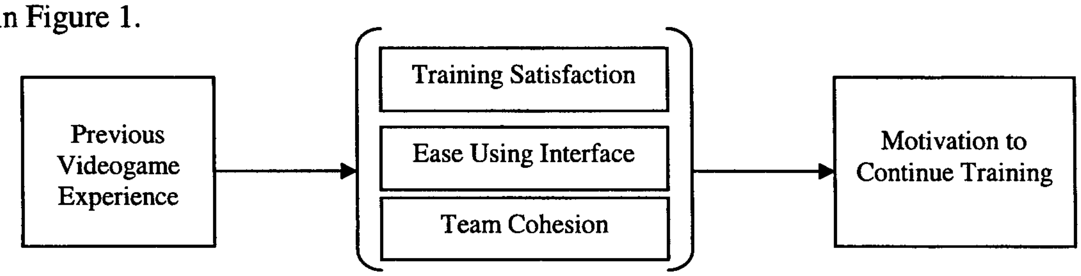

Figure 1. Conceptual model of training motivation

In terms of team cohesion as a mediator, prior research suggests that cohesive environments facilitate an individual's motivation to continue engaging in a team-based distance-learning environment. Team cohesion has been found to be positively related to group functioning in that more socially cohesive teams tend to possess more motivation to work together as a collective on a given task (Evans & Dion, 1991; Mullen et al., 1993; Mullen & Copper, 1994). Further, as mentioned previously, those with little experience working collaboratively in virtual learning environments may be less equipped with the knowledge of how to interact effectively in such environments. Therefore, they will have more difficulty forming cohesive relationships in similar future training environments. As such, trainees' perceptions of cohesion among their team members will mediate, in part, the extent to which prior videogame experience influences motivation to continue training with the videogame.

The extent to which trainees find it easy to use the game's user interface and overall enjoy the training experience (i.e., their satisfaction with the training) may also mediate the relationship between prior experience and training motivation. As aforementioned, if a training program is difficult to use and frustrating, a trainee will likely be less motivated to continue engaging in the training (Park & Tennyson, 1980; Tennyson, 1980). Moreover, trainees with greater levels of experience (e.g., those who frequently play videogames for personal enjoyment purposes) are likely to perceive the user interface of a given videogame-based training environment easier to use and should find the overall training experience more satisfying.

Multidimensional videogame experience. Similar to the acknowledgement of the multidimensional nature of computer experience, we suggest that previous videogame experience should be examined at a more specific level of analysis rather than only a unidimensional, global view of videogame experience. It is important to consider specific videogame experiences (i.e., an individual's experiences with particular types or genres of videogames) as well. Based on prior research on computer experience (e.g., Polman & Fishman, 1995; Woodrow, 1991), we propose that the impact of prior videogame experience on subsequent learner outcomes in a given game-based training environment will depend on the type of prior game experience one has acquired. Specifically, we hypothesize that only prior game experiences that share similar game characteristics to the given training game environment will influence learner outcomes; while experience with unrelated games (i.e., games do not share similar characteristics) will not predict learner outcomes (*Hypothesis 3*).

Demonstrating that the relationships between videogame experience and various learner outcomes are dependent on the specific types of experience amassed is valuable in furthering our understanding of game-based learning contexts. However, there have been several recent calls in the literature to go beyond the examination of bivariate correlations (e.g., Avis, Kudisch, & Fortunato, 2002; Clevenger, Pereira, Wiechmann, Schmitt, & Harvey, 2001; Cortina, Goldstein, Payne, Davison, & Gilliland, 2000). Accordingly, we suggest that additional information is gained by demonstrating incremental validity of the specific game experiences above and beyond more general videogame experience. The primary issue is whether relevant specific game experiences (for example, first-person-perspective videogames) account for variance in learner outcomes *beyond* that accounted for by a general measure of videogame experience. If an individual's report of his/her specific game experiences do not significantly contribute beyond the report of his/her overall game experience, there would be less utility in operationalizing

videogame experience as a multidimensional construct. We hypothesize that prior videogame experience with specific games that share similar characteristics with the training game will provide incremental validity over general videogame experience in the prediction of learner outcomes (*Hypothesis 4*).

Computer Self-Efficacy

In general, self-efficacy is a judgment of one's capability to successfully perform a specific task (Bandura, 1977). Self-efficacy judgments influence an individual's tendency to engage in a task as well as level of exertion and endurance exhibited (Bandura, 1995; Muira, 1987). Self-efficacy is situation specific or domain-specific construct in that it can vary across kinds of activities and tasks (Bandura, 1977). As such, computer self-efficacy has most frequently been examined as the type of self-efficacy beliefs relevant for computer-based training environments. Computer self-efficacy is a judgment of one's capability to use a computer to successfully perform a computer-based task (Compeau & Higgins, 1995).

Trainee self-efficacy beliefs have been found to be an important predictor of motivation to learn (Colquitt et al., 2000), trainee reactions to a training program (Mathieu, Martineau, & Tannenbaum, 1993), participation in learning activities (Maurer & Tarulli, 1994; Noe & Wilk, 1993; Zimmerman, 2000), amount of time spent practicing new skills (Bouffard-Bouchard, 1990), and learning and performance (Gist, Schwoerer, & Rosen, 1989; Martocchio & Judge, 1997; Martocchio & Webster, 1992) in various training contexts, including computer-based training contexts. In general, this research suggests that individuals with high self-efficacy tend to have more positive learner outcomes because of the persistence and effort demonstrated while completing a training program. Accordingly, trainee computer self-efficacy should be a significant predictor of learner outcomes in videogame-based training environments as well.

Further, research on computer-based training has demonstrated that computer self-efficacy is positively related to prior computer experience (e.g., Cassidy & Eachus, 2002; Dyck & Smither, 1996; Houle, 1996; Levine & Donitsa-Schmidt, 1997). As such, an important question is whether trainees' computer self-efficacy uniquely explains variance in the learner outcomes of a given videogame-based training program *beyond* that accounted for by videogame experience. In other words, is prior experience the significant driver of learner outcomes while self-efficacy is simply related to prior experience, *or* is computer self-efficacy a unique driver of the learner outcomes as well? Demonstrating the incremental validity of trainees' computer self-efficacy on learner outcomes would provide additional avenues by which instructors could enhance the effectiveness of game-based training environments. We hypothesize that computer self-efficacy will provide incremental validity over general videogame experience in the prediction of learner outcomes (*Hypothesis 5*).

Lastly, as an exploratory analysis, the current research will investigate whether prior general videogame experience and computer self-efficacy interact in the prediction of the four learner outcomes. Prior research has demonstrated that individual characteristics interact with one another to predict a variety of criteria such as job performance, counterproductive behaviors, and interview performance (Witt, 2002a; Witt, 2002b; Witt, Burke, Barrick, & Mount, 2002). For example, Witt et al. (2002) found that the relationship between conscientiousness and job

performance is stronger for individuals high in agreeableness than those low in agreeableness. We believe a similar case may be made in regards to the learner outcomes examined in the current research. Thus, we will explore whether the interaction among trainee computer self-efficacy and prior experience rather than their main effects alone predict the learner outcomes.

Method

Participants

Participants were 413 first-year U. S. Military Academy cadets taking part in a four-day inter-semester game-based tactics training exercise. The mean age of participants was 18.71 years (SD = .94 years). Following the four-day training exercise, cadets were given the opportunity to complete an online questionnaire for the current research. Completion of the research questionnaire, while encouraged by tactics instructors, was voluntary. Approximately 1100 cadets participated in the training exercise of which 414 of these cadets voluntarily completed the follow-up questionnaire.

Game

The game used as the training exercise was *America's Army*, an online, first-person perspective game with both single-player and multi-player sections. *America's Army,* created by the Office of Economic and Manpower Analysis at the U. S. Military Academy, was originally developed to serve as a recruiting tool in order to inform potential recruits about what to expect during basic training and about Army core values, history, and Army background. To date, over four million individuals have registered to play the game online (Petermeyer, 2004). This game was chosen for this exercise because of its ability to allow for the virtual simulation of small team maneuvers. Additional information regarding *America's Army* is available at www.americasarmy.com.

Procedure

During the four-day training exercise, cadets played the computer game online during their own time, at a location of their own preference. First, the cadets completed a "basic training" single-player section, where they learned how to play the game. This section contains four segments: a) marksmanship training, b) an obstacle course, c) weapons familiarization, and d) a MOUT (military operations in urban terrain) training mission. In the marksmanship segment, cadets practiced using a computer mouse to shoot a rifle. Practice and qualification rounds were repeated until the cadet qualified with his/her weapon (at least 23 out of 40 targets with 40 rounds). In the second segment, the obstacle course, cadets completed a course which includes obstacles such as climbing over a wall, running over a balance beam, and low crawling under barbwire. Cadets repeated the obstacle course until they bettered the time requirement of 90 seconds. In the weapons familiarization segment, cadets practiced using a computer mouse to operate four different weapons including a machine gun, rifle with a grenade launcher, fragmentation grenade, and smoke grenade. Cadets were not required to meet qualification standards with these weapons. In the final segment, MOUT training, cadets navigated through a building and several tunnels while being introduced to and practicing basic "rules of

engagement" (i.e., shooting at stationary silhouettes of "hostile" targets while not firing at the silhouettes of "noncombatant" targets). This section required the use of shooting and movement skills introduced in the prior three sections.

Once the basic training section had been completed, cadets were eligible to play the multi-player section of the game. In the multi-player section, cadets were placed into small teams and engaged in collaborative missions. They were required to play a minimum of three collaborative missions over the course of four days, with no maximum limit of missions set. Team membership was not fixed; instead, membership could vary across collaborative missions depending which cadets were currently online engaging in the game. In the mission, a team's goal was either to attack or to defend a radio tower. Regardless of the team's goal within a given mission, cadets took the perspective of a U. S. Soldier, while the opposing team was depicted as the enemy.

The multi-player section of *America's Army* represents a distributed, online environment because all team members engage in the same mission during "real" time. However, each team member plays the game on an individual computer, in a different physical location. Team members interact in terms of observing each other's actions during the "real time" mission and via written communication using an online chat feature built into the game interface.

At the end of the tactics training exercise, the instructor provided the website address of the online questionnaire and informed the cadets of their opportunity to participate in this research. Cadets were provided with a brief introduction to the questionnaire and promised confidentially of their responses. The questionnaire included both multiple-choice and open-ended questions. Interested cadets completed this questionnaire on their own time. Some cadets did not provide a response for all questionnaire items, but as long as the majority of items (at least 70 %) were completed a cadet's responses were included.

Measures

General game experience. General game experience was assessed using one item, "Based on the past year, how frequently have you played videogames (for example, PC-based, Nintendo, Playstation, arcade)?" Possible responses ranged from 1 (none) to 5 (much more than average).

Specific game experience. Prior game experience with specific games was assessed using a seven-item scale. Using a yes/no response (e.g., 0 or 1), cadets were asked to note whether they had frequently played a specific type of videogame. The seven types of specific game experience assessed were: a) first-person-shooter (e.g., Battlefield 1942, James Bond 007, Medal of Honor); b) simulation (e.g., Falcon, Microsoft Flight Simulator, Lock On:Modern Air); c) online multi-player games (e.g., EverQuest, Planetside); d) action (e.g., Grand Theft Auto, NBA, Car Racing); e) command/strategy (e.g., Risk, Chess); f) creative development (e.g., Sims, Tycoon, Civilization); and g) puzzle (e.g., Minesweeper). In addition, participants were asked to indicate the extent to which they had previously played *America's Army*. Possible responses for this item ranged from 1 (none) to 5 (much more than average).

Computer self-efficacy. Computer self-efficacy was assessed using one item, "What is your level of confidence using computers?" Possible responses ranged from 1 (low) to 5 (high).

Satisfaction with training. Satisfaction with the training experience was assessed using a six-item scale. Sample items include "I was satisfied with the experience of using the America's Army game" and "Using the America's Army game allowed me to better understand combat related cognitive skills and decision-making." Possible responses ranged from 1 (strongly disagree) to 5 (strongly agree)[1]. The coefficient alpha for this scale was deemed acceptable at .86. All items of this scale are provided in Appendix A.

Ease in using user interface. Ease in using the game's user interface was assessed with three items consisting of "How easy/difficult was it to learn how to use America's Army game?," "How easy/difficult was it to use the menu system?" (1 = very difficult to 5 = very easy), and "How comfortable did you feel using the system?" (1 = very uncomfortable to 5 = very comfortable)[1]. The coefficient alpha for this scale was deemed acceptable at .81.

Team cohesion. Trainee's perception of the cohesion among his/her team members was assessed using a nine-item scale adapted from Craig and Kelly (1999). Items were augmented slightly to fit the game environment. Sample items include "To what extent was your team engaged in the multi-player missions of the America's Army game?" and "To what extent did members of your team like being a part of this team?" Possible responses ranged from 1 (not at all) to 5 (great extent). The coefficient alpha for this scale was deemed acceptable at .95. All items of this scale are provided in Appendix A.

Training motivation. To assess motivation to continue training, an indirect measure (versus a more explicit, self-report measure of training motivation, e.g., Noe & Schmitt, 1986) was utilized. Cadets were asked to indicate the total number of hours spent playing the game during the four days allotted for this training exercise. Possible responses ranged from 1 (1-5 hours) to 4 (more than 15 hours). We believe that this is a reasonable means for assessing training motivation as videogame-based training represents a self-regulated voluntary training environment.

Prior game experience influence on military skills. To enhance our understanding of the influence of prior videogame experience, cadets were posed several open-ended questions. First, cadets were asked to address how their prior videogame experiences helped or hindered their acquisition/learning of military-related knowledge or skills. Comments were provided by 135 cadets. A post hoc organization of these comments was conducted. The majority of comments could be organized into four knowledge/skill areas. The areas of mission-related skills, team-related skills, functional and combat realism, and familiarity with weapons were selected as the areas in which to focus our discussion because they received the highest frequency of comments from participants. The remaining comments either did not address the question or represented over 13 different areas, none of which had a frequency of more than five participants providing a particular response. For sake of a concise description of findings, these areas will not be discussed.

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[1] These items were reverse coded for the statistical analyses so that higher values reflected greater satisfaction with the training and greater ease in using the interface.

In addition, cadets were asked if their prior experiences with videogames affected their military-related skills in regards to seven specific areas: a) decision making; b) building situational awareness; c) creating a common operating picture; d) multi-tasking; e) parallel processing of information; f) human understanding; and g) operating at a distance. Comments were provided by 174 cadets. A majority of the comments were classified into the seven areas. Participants also provided comments that could not be classified into these seven areas; these comments represented over 28 different areas, most of which had a frequency of five or less participants providing a particular response (or the comment did not address the question). For sake of a concise description of findings, these areas will not be discussed.

Interrater agreement for the coding was computed on a random selection of 25 percent of the comments. An Intra Class Correlation of .93 was obtained suggesting high interrater agreement. Discrepancies in coding were resolved by having the first and fourth authors discuss the comments until both authors came to an agreement regarding the correct coding.

Results

Descriptive Statistics

Means, standard deviations, and correlations of the relevant variables are displayed in Table 1. Results indicate that there is a wide range of prior videogame experience across the participants in this sample, with 17% of cadets reporting they have no experience playing videogames and 44% reporting they have limited videogame experience. The majority of participants reported possessing average to high computer self-efficacy, with 42% of cadets indicating an average level of confidence in using computers and 49% indicating above average confidence levels.

Table 1. *Means, Standard Deviations, and Correlations of Variables*

Variable	M	SD	1	2	3	4	5	6	7
1. General videogame experience	2.44	1.05	--						
2. Computer self-efficacy	3.55	.92	$.33^{**}$	--					
3. America's Army experience	1.59	.89	$.35^{**}$	$.21^{**}$	--				
4. First-person-shooter experience	.63	.48	$.45^{**}$	$.27^{**}$	$.24^{**}$	--			
5. Training satisfaction	3.40	.72	$.33^{**}$	$.14^{**}$	$.32^{**}$	$.25^{**}$	--		
6. Team cohesion	2.96	.98	$.33^{**}$	$.22^{**}$	$.32^{**}$	$.23^{**}$	$.45^{**}$	--	
7. Ease in using interface	3.63	.76	$.37^{**}$	$.30^{**}$	$.26^{**}$	$.36^{**}$	$.38^{**}$	$.42^{**}$	--
8. Training motivation	1.55	.78	$.20^{**}$	$.19^{**}$	$.19^{**}$	$.10^{+}$	$.21^{**}$	$.22^{**}$	$.11^{*}$

Note. Across variables, N ranged from 246 to 413. All variables were measured on a 1-5 scale except first-person-shooter experience (measured on a 0-1 scale) and training motivation (measured on 1-4 scale). $^{+}p < .10$. $*p < .05$. $**p < .01$ (two-tailed).

Role of General Videogame Experience

The first two hypotheses examined the role of prior general videogame experience on learner outcomes. In support of Hypothesis 1, a general measure of prior videogame experience significantly predicted the learner outcomes. Specifically, frequency in playing videogames was positively related to perceptions of ease in using the game's interface ($r = .37, p < 01$), cohesion with one's team members ($r = .33, p < .01$), satisfaction with the training game experience ($r = .33, p < .01$), and motivation to continue training with the game ($r = .20, p < .01$). This indicates that the more experience individuals have playing videogames, the more comfortable and satisfied they are using the training videogame, the more cohesive they feel with their teammates, and the more motivated they are to continue using the game for training purposes.

Hypotheses 2 proposed a conceptual model in which the influence of prior general videogame experience on motivation to continue training is mediated by training satisfaction, ease in using the game's interface, and team cohesion. Using the mediated regression steps outlined by Baron and Kenny (1986), reported cohesion with one's teammates appeared to be the only mediator of the relationship between general videogame experience and training motivation. Ease in using the game's interface and training satisfaction did not mediate this relationship. The results are presented in Table 2.

Table 2. *Regression Analyses for Training Satisfaction, Team Cohesion, and Ease in Using the Interface Mediating the Relationship Between General Videogame Experience and Training Motivation.*

Analysis/Variable	B	SE B	β	R^2	ΔR^2
DV = Training satisfaction					
General videogame experience	.22	.03	$.33^{**}$	$.11^{**}$	$.11^{**}$
DV = Team cohesion					
General videogame experience	.30	.06	$.33^{**}$	$.11^{**}$	$.11^{**}$
DV = Ease in using interface					
General videogame experience	.27	.04	$.37^{**}$	$.14^{**}$	$.14^{**}$
DV = Training motivation					
Step 1				$.03^{**}$	$.03^{**}$
General videogame experience	.14	.05	$.18^{**}$		
Step 2				$.06^{**}$	$.03^{*}$
General videogame experience	.08	.06	.11		
Training satisfaction	.08	.08	.07		
Team cohesion	.13	.06	$.15^{*}$		
Ease in using interface	.00	.09	.00		

Note. N = 363, 244, 357, and 227, for each aforementioned DV, respectively. $^{*}p < .05$. $^{**}p < .01$.

A follow-up analysis was conducted examining team cohesion as the sole mediator of the general videogame experience - training motivation relationship. The results, as reported in Table 3, suggest that reported cohesion with one's teammates significantly mediated this relationship. Videogame experience significantly predicted training motivation in Step 1. However, after accounting for the influence of team cohesion in Step 2, videogame experience no longer had a significant effect (at the $p < .05$ level). Finally, as recommended by Baron and Kenny (1986), the Sobel test, a statistical test of the mediation effect, was conducted to provide

additional support. The Sobel test demonstrates that cohesion was a statistically significant mediator for this relationship ($z = 2.32, p < .05$). It is important to note, that the three proposed mediators were intercorrelated. Thus, although ease in using the game's interface and training satisfaction did not demonstrate a significant mediational effect, these variables are relevant to trainees' motivation to continue training.

Table 3. *Regression Analyses for Team Cohesion Mediating the Relationship Between General Videogame Experience and Training Motivation.*

Analysis/Variable	B	SE B	β	R^2	ΔR^2
DV = Team cohesion					
General videogame experience	.30	.06	$.33^{**}$	$.11^{**}$	$.11^{**}$
DV = Training motivation					
Step 1				$.03^{**}$	$.03^{**}$
General videogame experience	.14	.05	$.17^{**}$		
Step 2				$.06^{**}$	$.03^{**}$
General videogame experience	.09	.05	$.12^{+}$		
Team cohesion	.15	.06	$.18^{**}$		

Note. $N = 244$ and 228, for each aforementioned DV, respectively. $^{+}p < .10$. $^{*}p < .05$. $^{**}p < .01$.

Role of Specific Videogame Experience

Hypotheses 3 and 4 examined the role of prior videogame experience with *specific* games on learner outcomes. To test Hypothesis 3, four regression analyses were conducted, where each of the four learner outcomes (team cohesion, training satisfaction, ease in using the game's interface, and training motivation) were regressed onto the eight specific types of game experiences. Results indicate that generally only prior experiences related to the videogame used in the training were significant predictors. Specifically, previous experience with the *America's Army* game was a unique predictor for all four learner outcome variables. Prior experience with other first-person-shooter games was also a significant predictor of training satisfaction and ease in using the game's interface; it approached significance for team cohesion. As expected, experience using other types of specific games which did not share several similar characteristics to the current training game, such as puzzles and creative development games, were not predictive of these four outcomes. An unexpected result is that prior simulation experience predicted training motivation. We revisit this unexpected finding in the discussion section. Results are presented in Table 4.

To test Hypothesis 4, whether prior specific videogame experience provides incremental validity over general videogame experience in the prediction of the four learner outcomes, a separate regression analysis was performed for each learner outcome. For each regression analysis, general videogame experience was entered first, followed by a block of variables in Step 2 consisting of the genre specific videogame experiences of prior *America's Army* experience and first-person-shooter videogame experience. Results indicate that prior *America's Army* experience and first-person-shooter experience predicted unique variance above and beyond general videogame experience for two of the four dependent variables, training satisfaction and ease in using the game's interface. For the other two dependent variables, prior *America's Army* experience significantly contributed above and beyond general videogame

experience for team cohesion and approached significance (p = .06) for motivation to continue training with the game. In short, genre-specific game experience predicts the learner outcomes of interest beyond what is explained by globally reported videogame experience alone. As such, there is value to measuring trainees' prior specific game experiences as well as their general videogame experience. Results are presented in Table 5.

Table 4. *Regression Analyses for Specific Videogame Experiences Predicting Team Cohesion, Training Satisfaction, Ease in Using the Interface, and Training Motivation.*

	Cohesion			Satisfaction			Ease Using Interface			Motivation		
Variable	B	SE B	β	B	SE B	β	B	SE B	B	B	SE B	β
America's Army	.29	.07	.27**	.21	.04	.26**	.12	.04	.14**	.11	.05	.12*
First-person-shooter	.25	.14	.12^{+}	.24	.09	.16**	.38	.09	.24**	-.01	.10	-.01
Simulation	-.03	.18	-.01	.02	.11	.01	.10	.11	.04	.35	.13	.16**
Online multi-player	-.02	.18	-.01	-.01	.11	-.01	.20	.11	.09^{+}	.20	.13	.09
Action	.18	.13	.09	.08	.08	.05	.07	.08	.04	-.03	.09	-.02
Command/ strategy	.09	.14	.05	.13	.08	.09	.13	.09	.09	.04	.10	.02
Creative development	.04	.15	.02	-.12	.09	-.07	.10	.10	.06	.17	.10	.09
Puzzles	-.02	.12	-.01	.09	.07	.06	-.06	.08	-.04	-.06	.09	-.04

Note. $R^2 = .14^{**}, .14^{**}, .20^{**}$, and $.09^{**}$, for team cohesion, training satisfaction, ease in using interface, and training motivation, respectively. *N* = 244, 362, 356, and 336, for each DV, respectively. $^{+}p < .10$. $^{*}p < .05$. $^{**}p < .01$.

Table 5. *Incremental Validity Results of Specific Videogame Experiences Over General Videogame Experience.*

	Cohesion			Satisfaction			Ease Using Interface			Motivation		
Regression step	B	SE B	β	B	SE B	β	B	SE B	β	B	SE B	β
Step 1												
General game experience	.30	.06	.33**	.22	.03	.33**	.27	.04	.37**	.15	.04	.20**
Step 2												
General game experience	.20	.06	.21**	.14	.04	.20**	.16	.04	.23**	.11	.05	.15*
AA experience	.24	.07	.23**	.17	.04	.21**	.10	.04	.11*	.12	.05	.13*
First person shooter experience	.19	.13	.09	.16	.08	.11*	.38	.08	.24**	.01	.10	.01

Note. $R^2 = .11^{**}$ for Step 1; $\Delta R^2 = .06^{**}$ for Step 2, for team cohesion. $R^2 = .11^{**}$ for Step 1; $\Delta R^2 = .05^{**}$ for Step 2, for training satisfaction. $R^2 = .14^{**}$ for Step 1; $\Delta R^2 = .06^{**}$ for Step 2, for ease in using interface. $R^2 = .04^{**}$ for Step 1; $\Delta R^2 = .02^{+}$ for Step 2, for training motivation. *N* = 244, 363, 357, and 337, for team cohesion, training satisfaction, ease in using interface, and training motivation, respectively. $^{+}p < .10$. $^{*}p < .05$. $^{**}p < .01$.

To identify whether the observed mediation effect of team cohesion on the relationship between videogame experience and motivation would generalize to specific videogame experiences, a post-hoc exploratory mediated regression analysis was conducted. Prior *America's Army* experience was chosen as the independent variable because it was a significant predictor of training motivation. Similar to the findings for general videogame experience, cohesion with one's teammates was found to partially mediate the relationship between prior *America's Army* experience and training motivation using the mediated regression steps outlined by Baron and Kenny (1986). Results are presented in Table 6. Further, the Sobel test demonstrates that team cohesion was a statistically significant partial mediator for this relationship ($z = 2.17, p < .05$).

Table 6. *Regression Analyses for Team Cohesion Mediating the Relationship Between Prior America's Army Videogame Experience and Training Motivation.*

Analysis/Variable	B	S.E.	β	R^2	ΔR^2
DV = Team cohesion					
America's Army experience	.34	.06	.32**	.10**	.10**
DV = Training motivation					
Step 1				.05**	.05**
America's Army experience	.20	.06	.23**		
Step 2				.08**	.02*
America's Army experience	.16	.06	.18**		
Team cohesion	.14	.06	.16*		

Note. $N = 244$ and 228, for each aforementioned DV, respectively. $^{*}p < .05$. $^{**}p < .01$.

Role of Computer Self-Efficacy

The final research question examined the role of computer self-efficacy on learner outcomes. Hypothesis 5, that computer self-efficacy will provide incremental validity over general videogame experience in the prediction of the four learner outcomes, was tested using a separate regression analysis for each learner outcome. For each regression analysis, general videogame experience was entered first, followed by computer self-efficacy in Step 2. The results of the regression analyses indicate that computer self-efficacy explained statistically significant variance above and beyond general videogame experience for the criteria of team cohesion, ease in using the interface, and training motivation. However, computer self-efficacy did not account for additional variance in training satisfaction beyond that accounted for by general videogame experience. In short, computer self-efficacy contributed to the prediction of three of the learner outcomes beyond what was explained by globally reported videogame experience alone. Results are presented in Table 7.

Lastly, an exploratory analysis to examine whether prior general videogame experience and computer self-efficacy interact in the prediction of the four learner outcomes was conducted. Using a separate regression analysis for each of the four outcomes, general videogame experience and computer self-efficacy were entered into the equation in Step 1. In Step 2, the interaction term between videogame experience and computer self-efficacy was entered. Interaction terms generally correlate with the variables from which they are created; therefore, to reduce multicollinearity, the independent variables were centered around zero by subtracting

each value from its respective mean before creating the interaction terms (Aiken & West, 1991; Cronbach, 1987). This transformation does not affect the correlations among the variables, yet it allows for better estimates of the interaction terms.

The results, reported in Table 8, demonstrate that computer self-efficacy moderated the relationship between general videogame experience and training motivation ($\beta = .15, p < .01$). As shown in Figure 2, similar to our previously reported results, trainees with higher levels of computer self-efficacy report greater motivation to continue training with the game than those with lower levels of computer self-efficacy. Further, trainees with higher levels of prior videogame experience report greater motivation to continue training than those with lower levels of videogame experience. Most importantly, these results suggest that trainees who possess both a high level of computer self-efficacy *and* prior experience report the highest levels of training motivation. The interactions between computer self-efficacy and general videogame experience for training satisfaction, ease in using game's interface, and team cohesion were not significant.

Table 7. *Incremental Validity Results of Computer Self-Efficacy Over General Videogame Experience.*

	Cohesion			Satisfaction			Ease Using Interface			Motivation		
Regression step	B	SE B	β	B	SE B	β	B	SE B	β	B	SE B	β
Step 1												
General game experience	.30	.06	$.33^{**}$	.22	.03	$.33^{**}$	.27	.04	$.37^{**}$	.15	.04	$.20^{**}$
Step 2												
General game experience	.27	.06	$.28^{**}$	.21	.04	$.31^{**}$	.22	.04	$.31^{**}$	.12	.04	$.16^{**}$
Computer self-efficacy	.15	.07	$.14^{*}$	.03	.04	.04	.16	.04	$.20^{**}$	.12	.05	$.14^{**}$

Note. $R^2 = .11^{**}$ for Step 1; $\Delta R^2 = .02^{*}$ for Step 2, for team cohesion. $R^2 = .11^{**}$ for Step 1; $\Delta R^2 = .00$ for Step 2, for satisfaction. $R^2 = .14^{**}$ for Step 1; $\Delta R^2 = .04^{**}$ for Step 2, for ease in using interface. $R^2 = .04^{**}$ for Step 1; $\Delta R^2 = .02^{**}$ for Step 2, for training motivation. $N = 244$, 363, 357, and 337, for team cohesion, training satisfaction, ease in using interface, and training motivation, respectively. $^{*}p < .05$. $^{**}p < .01$.

Table 8. *Interaction Between General Videogame Experience and Computer Self-Efficacy on Training Motivation*

Regression step	B	SE B	β
Step 1			
General videogame experience	.12	.04	$.16^{**}$
Computer self-efficacy	.12	.05	$.14^{**}$
Step 2			
General videogame experience	.11	.04	$.14^{**}$
Computer self-efficacy	.15	.05	$.17^{**}$
Experience X Self-efficacy	.12	.04	$.15^{**}$

Note. $R^2 = .06^{**}$ for Step 1; $\Delta R^2 = .02^{**}$ for Step 2; $N = 337$. $^{**}p < .01$.

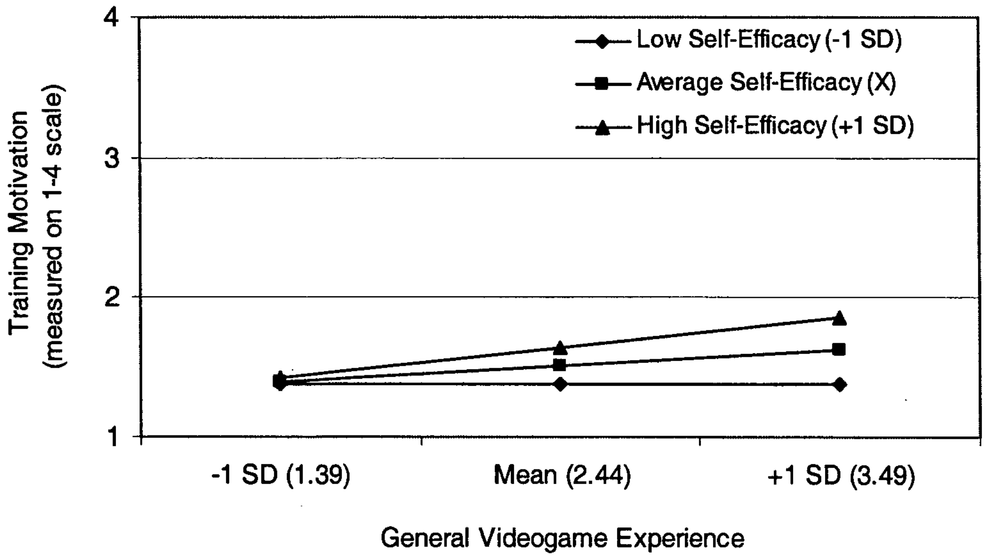

Figure 2. Significant interaction between general videogame experience and computer self-efficacy on training motivation.

Influence of Prior Game Experience on Military Skills

As a means for further enhancing our understanding of the influence of prior videogame experience, participants were asked several open-ended questions. First, cadets were asked how their prior videogame experience (or any other digital-related experience) helped or hindered any of their military-related knowledge or skills. Of the 135 cadets who provided responses, mission-related skills, such as problem solving and attention to detail, was the most commonly mentioned skill area enhanced by prior videogame experiences (19% of responses). Cadets reported that their gaming experience allowed them to practice and become more adept at various skills related to the execution of tactical maneuvers. For instance, one cadet stated, "My attention to detail when under stress has increased, and my target-acquisition skills have increased." The enhancement of team-related skills, such as communication and learning to stay organized as a combat team, was the second most common advantage reported (16% of responses).

With respect to whether prior videogame experience hindered any military-related knowledge or skills, the most common disadvantage reported was the lack of functional and combat realism (16% and 11% of responses, respectively) when learning military-related skills in a gaming environment. As one cadet responded, "A person cannot learn to fire a weapon efficiently by learning from a videogame, [and] an individual ought to actually experience the pain and other emotions that actually come with combat." Cadets often reported they engaged in reckless, careless or otherwise ill-advised behaviors during game play due to the availability of a restart option. Cadets also mentioned the potential of this behavior to create bad habits that may carry over to real combat situations.

In addition, cadets were asked if their prior experiences with videogames and other digital technologies affected their military-related skills in regards to seven specific areas: a) decision making; b) building situational awareness; c) creating a common operating picture; d) multi-tasking; e) parallel processing of information; f) human understanding; and g) operating at a distance. Of the 174 cadets who provided responses, two common themes were identified which suggest that prior experience enhances military-related skills. Cadets indicated that their decision-making skills were aided by prior videogame experience (29% of responses), either by making a general reference this skill area (16%) or a specific statement, such as videogames enhancing their ability to make more decisive or faster decisions (13%). Cadets also commonly reported their prior experience aided their ability to multitask by keeping track of multiple situational variables (20% of responses).

Discussion

This research extends the current research by demonstrating the importance of prior videogame experience and computer self-efficacy for the prediction and explanation of learner outcomes in videogame-based training. Our findings in relation to trainees' general videogame experience, specific game experiences, and computer self-efficacy are discussed respectively below. In addition, the relevance of prior videogame experience to military skills is discussed. Finally, practical implications of the current research and future research directions are provided.

General Videogame Experience

The results of this research suggest that trainees' prior experience has implications for several learner outcomes in a videogame-based training environment. Specifically, more experienced trainees reported greater ease using the training game's interface, higher levels of training satisfaction, and increased motivation to continue training with the game. This supports past research indicating that the exposure to computers and videogames is meaningful to a learner's experience in a game-based learning environment (Gagnon, 1985; Greenfield, deWinstanley, Kilpatrick, & Kaye, 1996; Subrahmanyam & Greenfield, 1996; Young et al., 1997).

The results also demonstrate that previous videogame experience has implications for videogame-based training environments which require trainee collaboration. In the current research, trainees with higher levels of experience more easily formed cohesive relationships with team members in the collaborative components of the training game, as compared to trainees who had less prior experience. Moreover, perceived team cohesion was found to be a significant mediator of the relationship between prior experience and motivation to continue engaging in the game, such that trainees with greater prior game experience perceived greater team cohesion and consequently spent more time engaging in the game. This finding intuitively makes sense given that our measure of training motivation primarily captures a trainee's motivation to continue using the *multi-player* component of *America's Army*. Accordingly, a trainee's perceived cohesion among his/her team members should be particularly influential on the length of time spent playing the multi-player component. These findings corroborate prior cohesion research which suggests that higher levels of cohesion improve a team's functioning

and collective motivation to engage in a collaborative task (Evans & Dion, 1991; Mullen et al., 1993; Mullen & Copper, 1994).

Specific Videogame Experience

The results suggest that the specificity of a trainee's prior experience predicts learner outcomes. Trainees with greater experience in playing games related to the current training game environment, such as *America's Army* and other first-person-shooter games, reported greater ease in using the game's interface, higher levels of training satisfaction, and greater team cohesion. Prior experience with *America's Army* also predicted motivation to continue engaging in the training game. In contrast, prior experiences with specific games that do not share similar characteristics with the current game-based training environment were generally not related to learner outcomes.

At first glance, one might have expected that online multi-player games would share several similarities with the multi-player component of *America's Army*; and thus should have significantly predicted learner outcomes, particularly team cohesion. While other multi-player videogames developed and popularized in the private sector (e.g., *Ultima Online, Everquest*) do simultaneously engage multiple individuals in game play, such games represent a very different game playing experience than *America's Army*. First, the number of players interacting within the game at any one time is vastly different. For this research, participants playing *America's Army* were formed into teams composed of a maximum of 16 players. Then, each team interacted with one opposing team of a similar size. Thus, only a relatively small number of individuals were interacting in the game environment at any one time. Games such as *Everquest* are termed massively multi-player games because thousands of individuals are simultaneously involved in game play and the number of teams that can exist is not limited. Another distinction is that in the current training exercise with *America's Army*, individuals were randomly assigned to a team and membership in those teams varied regularly; while in most online multi-player games, team membership is emergent and more consistent over time. Individual's prior experience collaborating with specific players based on one's own selection is likely to be a different experience than that of collaboration with other individuals assigned as one's team members.

One unexpected finding was that prior simulation game experience (e.g., with *Falcon, Microsoft Flight Simulator, Lock On: Modern Air*) was positively related to training motivation for the *America's Army* game. A possible explanation is that simulation games are more closely associated to training well-defined skills (versus solely providing entertainment) as compared to other types of videogames. Another explanation may be that *America's Army* and simulations share some common game features or characteristics (e.g., fast-paced game environment) that are critical to game success.

The results indicate that specific prior game experiences that share similar characteristics with the intended training environment provide incremental validity over general videogame experience in the prediction of learner outcomes. In other words, knowledge of both trainees' general and specific videogame experiences is valuable in predicting their future experiences with and reactions to a given game-based training environment.

Computer Self-Efficacy

Trainees' computer self-efficacy was also influential in predicting trainees' learner outcomes such that trainees with higher computer self-efficacy beliefs reported less difficulty using the game's interface and higher levels of perceived team cohesion, training satisfaction, and training motivation than trainees with lower computer self-efficacy beliefs. Trainees' computer self-efficacy also demonstrated incremental validity over general videogame experience in the prediction of all of the learner outcomes except training satisfaction. In other words, knowledge of both an individual's prior experience and his/her level of self-efficacy provide unique information to the prediction of the individual's reactions to and experiences with the forthcoming game-based training. This aligns with prior research suggesting that self-efficacy and experience are important predictors of various training criteria (Dyck & Smither, 1996; Martocchio & Webster, 1992; Mathieu, Martineau, & Tannenbaum, 1993; Woodrow, 1991). Further, the results suggest that trainees who had both a high level of computer self-efficacy and videogame experience possessed the highest levels of training motivation. Thus, trainee motivation is highest not only when trainees have experience with games, but also when they feel confident that they can work well in that environment.

Influence of Prior Game Experience on Military Skills

The results of the open-ended questions indicate that prior videogame experience can both help and hinder trainees' military-related knowledge or skills. Specifically, cadets reported that prior gaming experience enhance mission-related skills (including decision-making/problem solving, multi-tasking, and attention to detail) and team-related skills (including communication and team organization). In contrast, first-year cadets reported that prior videogame experience has the potential to hinder performance in real combat situations. Reckless or careless combat behaviors demonstrated during game play, due to the lack of functional and combat realism of a gaming environment, have the potential to carry over to real combat situations.

Implications and Conclusions

Based on the current research findings, we suggest some practical implications for instructors and training games developers, as well as some future research directions. First, for instructors utilizing training games, we provide support for the value of assessing trainees' specific types of game experience. It seems intuitive that if one has prior general videogame experience, he/she should have more positive experiences in any videogame-based training environment. However, based on the current research, this is not the case. Experience with one type of gaming environment does not necessarily enhance the training outcomes in a different type of training game environment.

The good news is that learner experience is a malleable trainee characteristic that can be compensated for fairly easily. By assessing the amount and types of previous gaming experiences trainees possess, instructors will be able to identify those who lack the prerequisite game experience. In turn, instructors can then provide these trainees with targeted opportunities to gain such beneficial experiences prior to training. For example, if learners are to engage in a first-person-shooter game-based training program and some learners have little prior experience

with this type of game, then the instructor would know to give them ample practice time before the learning segment of the training (i.e., when learners are acquiring the new skills or knowledge taught in the game). To facilitate instructors in providing the appropriate amount of preparatory practice for a given learner's needs, training game developers should incorporate a feature within the game that enables the instructor to select the desired amount and content of trainee orientation and practice.

Further, it may be assumed that most junior Soldiers who grew up in the digital age would have a great deal of experience with videogames. However, this assumption does not seem warranted given the experience levels of the military academy cadets sampled. In the current sample, 17% of cadets reported they had no experience playing videogames and 44% reported they had limited videogame experience. Given the number of cadets with little to no experience, providing an orientation or additional practice with relevant games *would* likely be valuable. Doing so may improve a host of learner outcomes including training satisfaction, perceived team cohesion, ease in using the game's user interface, and the length of time devoted to training.

This research also suggests that a Soldier's level of computer self-efficacy is positively related to trainee learner outcomes. As such, it may also be valuable for instructors to assess trainees' computer and videogame related self-efficacy beliefs. Instructors could bolster the self-efficacy of those learners who question their current capability to successfully train in a game-based learning environment. One may argue that "providing" trainees with greater self-efficacy is more difficult to achieve than influencing trainees' videogame experience levels. However, prior research demonstrates that there is a positive relationship between experience and self-efficacy (Dyck & Smither, 1996; Henderson et al., 1995; Levine & Donitsa-Schmidt, 1997). When instructors are providing additional experiences with a relevant type of videogame, it is also likely that trainees will feel more confident using such games. Another way to enhance trainee self-efficacy may be to provide positive feedback and encouragement while trainees are beginning to maneuver through the training game. Such feedback could be provided by the instructor or could be built into the videogame content and delivered during game play or a pre-training/familiarization exercise. These suggestions are supported by Bandura (1997) who proposed that obtaining experiences resulting in successful performance or receiving feedback on one's capabilities are two ways in which to develop positive self-efficacy beliefs.

We suggest that future research investigate the impact of additional practice with videogames and of feedback regarding one's game performance on a trainee's self-efficacy and learner outcomes of videogame-based training environments. Future research should also examine the influence of self-efficacy as it relates to videogames versus the more general measure of self-efficacy in using *computers*. It is likely that self-efficacy beliefs related to general gaming environments, and specific types or genres of videogames, will account for unique variance in learner outcomes of game-based training programs beyond that of general *computer* self-efficacy. This would parallel the current research which demonstrated that the measurement of specific game experience is valuable beyond general game experience in predicting learner outcomes.

Finally, future research should examine the role of trainee *preference* for videogames on learner outcomes. In the real world, videogame preference and prior experience should be positively correlated, such that the more one enjoys a type of videogame, the more frequently he/she plays this kind of game. An important question is whether it is one's prior experience with videogames that influences subsequent learner outcomes or whether these relationships are a function of the individual's preference for playing these games. It is possible that actual enjoyment or preference for game playing may be driving the relationships between game experience and learner outcomes of the training.

In conclusion, the way the Army conducts its training is transforming. Desktop simulations and gaming technology are being incorporated into a broad range of training environments. The current research has implications for our Soldiers' training motivation and other important learner outcomes in videogame-based training environments. Maximizing these proximal learner outcomes should influence Soldiers' overall training performance and ultimately enhance their operational capabilities.

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Appendix A

Satisfaction with Training scale Response options: 1 *(strongly agree)* to 5 *(strongly disagree)*
1. Using America's Army game allowed me to better understand combat-related cognitive skills and decision-making. 2. Using America's Army game allowed me to become more comfortable with being a member of a combat team. 3. Using America's Army game allowed me to better understand how the members of a combat team must work together to be successful. 4. My performance while using America's Army game accurately reflects my knowledge of small team combat tactics. 5. I was satisfied with the experience of using America's Army game. 6. I was satisfied with my personal performance during America's Army game.
Team Cohesion scale Response options: 1 *(not at all)* to 5 *(great extent)*
1. To what extent was your team engaged in the multiplayer missions of the America's Army game? 2. To what extent did your team enjoy working on the America's Army game? 3. To what extent did your team treat the exercise using America's Army game as meaningful and important? 4. To what extent did you expect your team to derive benefits from a successful team performance during America's Army game? 5. To what extent did the members of your team like each other? 6. To what extent was it important that the members of your team got along with one another? 7. To what extent did the members of your team feel similar to one another? 8. To what extent was it important for members of your team to communicate during the mission? 9. To what extent did members of your team like being a part of this team?